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Future Development-The PHE Improvement Study

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Introduction

- SGS recently completed a study for the KSC Propellants and Life Support Office.
- The study covered the technical relevance and feasibility of user recommended upgrades to improve user operability and safety of the Propellant Handlers Ensemble.
- This presentation will review the results of the study.

Background

- KSC established priority study topics
 - Tackiness
 - Dexterity / Agility
 - Suit Relief Valve
 - Visibility
 - Sizing
 - Electrostatic Discharge (ESD)



Tackiness

- Anti-static spray is used to control electrostatic discharge.
- Anti-static spray leaves tacky residue on fabric, gloves, and communication cable.
- Anti-static spray changed to a water based spray to eliminate tacky condition.

Tackiness

- Liquid hydrazine leaves a viscous residue on butyl rubber gloves.
- Condition is eliminated by a water wash.
- Atmospheric carbon dioxide reaction with hydrazine producing carbazic acid

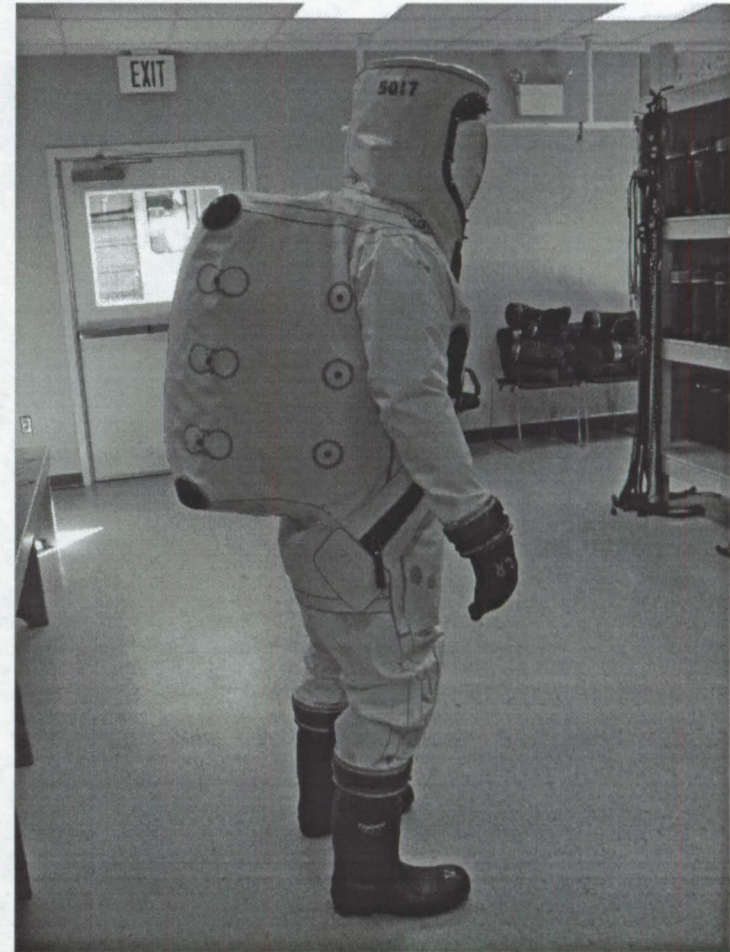
Dexterity / Agility

- Unable to relocate Disconnect
- Disconnect is rigid
- Gloves are cumbersome
- Suit is heavy, fabric gathers at the legs
- Suit is too large / too small
- Sleeves and legs are too long / too short



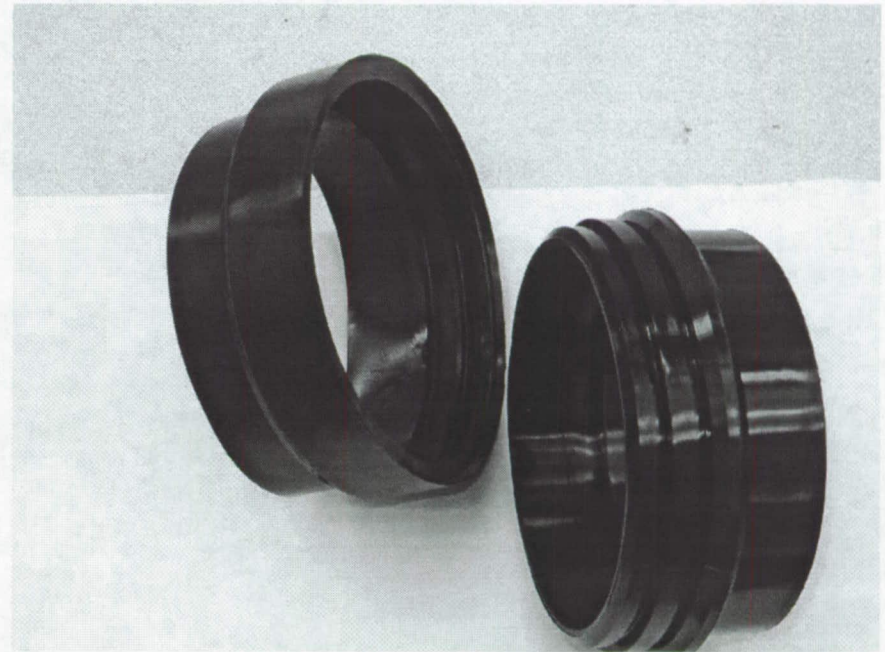
Dexterity / Agility

- Gloves are not tactile
- PHE is cumbersome
- Thick gloves are required.
- Training improves performance



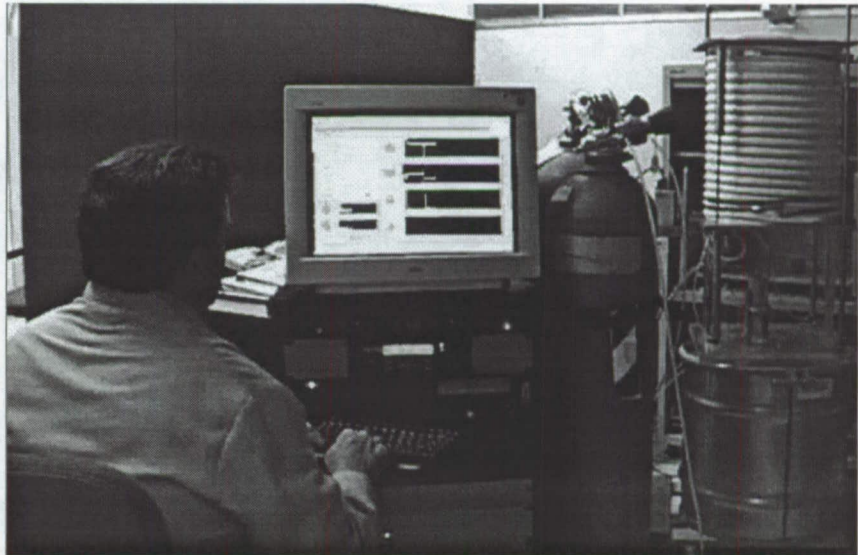
Dexterity / Agility

- A Flexible Cuff with a larger inside diameter is being considered.
- Adding another suit size improves fitting.



Relief/Exhaust Valves

- Maintains positive pressure in suit
- Deep squatting can lead to Negative pressure
- Require Faster closing response
- Test Bed
 - Model actual conditions
 - Exhaust mode
 - Reverse flow
 - Static



Results

| | Exhaust PPM/MIN | Reverse Flow PPM | Static PPM/SEC |
|-----------------|--------------------|---------------------|-------------------|
| Relief Valve A | 5 | 2 | 1 |
| Exhaust Valve B | 1 | 1 | 5 |
| Exhaust Valve C | 2 | 5 | 3 |
| Exhaust Valve D | 3 | 3 | 2 |
| Exhaust Valve E | 4 | 4 | 4 |

Visibility

- Visor Materials
 - Polyvinyl Chloride, Bubble contour
 - Polycarbonate with hardcoat, single plane curvature
- Hood
 - Stove Pipe Configuration
 - Fabric Construction
 - Communication system with microphone



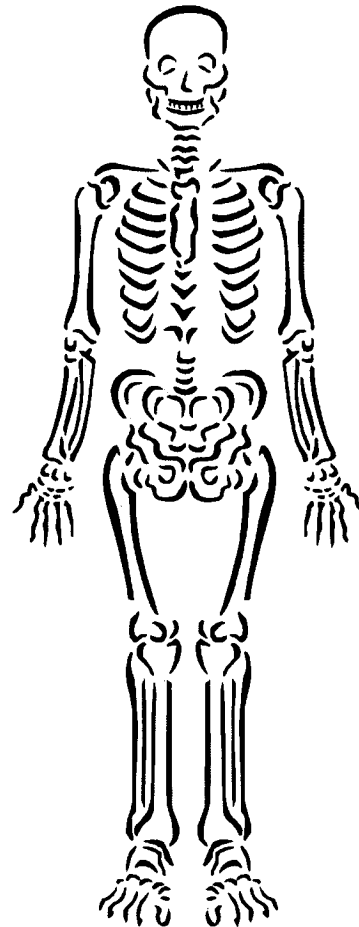
Visibility

- Surface scratches produced glaring
 - Soft covers reduced scratches and glare
- Reduced visibility; horizontal / vertical
 - Correct suit size reduces visibility issue
- ESD- visor materials are insulative
 - Anti-static spray non-compatible
- ESD is still a concern.



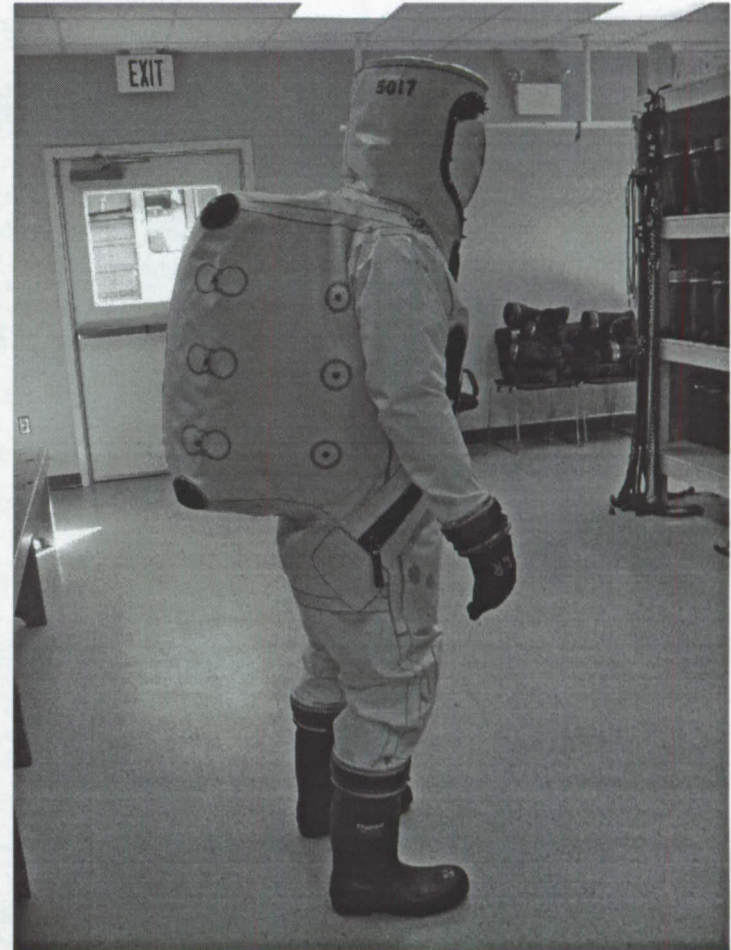
Sizing

- PHE is designed to 1970 Military data
- KSC conducted anthropometric survey plus opinion survey
- User physical attributes changed
- Identified PHE misfit characteristics
- Identified most used sizes



Sizing

- Patterns photographed, scanned, validated
- Pattern Modification
 - Back Pack & Hood
- Fit Testing
- Corrected 75% of issues..



ESD

- Antistatic Spray in use presently
- ESD Coating using Nanotechnology
- ESD event during biomedical test
- Understand ESD (ESPL)
- Test select fabrics
 - Resistance Test
 - Charge Decay
 - Surface Potential

ESD

- ESD Events
- Spark Incendivity

Summary

- The results of this study will be used by KSC to provide a basis for upgrades that will enhance user operability and safety in future versions of the Propellant Handlers Ensemble or implemented as “drop-in” improvements to the existing Propellant Handlers Ensemble inventory.